Research Article

Genetic variability studies in *Gossypium barbadense* L. genotypes for seed cotton yield and its yield components

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Abstract

A study was carried out during kharif 2006-07 with twenty five *Gossypium barbadense* L genotypes to obtain information on genetic variability, heritability and genetic advance for seed cotton yield and its yield attributes. Significant differences were observed for characters among genotypes. High genetic differences were recorded for nodes/plant, sympodia, bolls as well as fruiting points per plant, seed cotton yield, lint index indicating ample scope for genetic improvement of these characters through selection. Results also revealed high heritability coupled with high genetic advance for yield and most of the yield components as well as fibre quality traits. Sympodia/plant, fruiting point /plant, number of nodes/plant, number of bolls per plant, and lint index were positively correlated with seed cotton yield per plant and appeared to be interrelated with each other. It is suggested that these characters could be considered as selection criteria in improving the seed cotton yield of *G. barbadense*, L genotypes.

Key words: *Gossypium barbadense*, genetic variability, heritability, genetic advance, lint index, selection criteria

Introduction

Cotton is the most widely used vegetable fibre and also the most important raw material for the textile industry, grown in tropical and subtropical regions in more than 80 countries all over the world. World consumption of cotton fibre is approximately 115 million bales per year. Pima cotton or Egyptian cotton, *Gossypium barbadense* is known for its better fibre properties being cultivated in less than 2% in the world (Chen *et al*. 2007). In India, long and extra long staple cotton is widely grown in South Zone states of Tamil Nadu, Andhra Pradesh and Karnataka as the climatic requirement for growing this cotton are more conducive and there has been a heavy demand for this cotton in the recent past in textile industry. The current production of extra long staple cotton is only 0.5 million bales, but the requirement of long and extra long staple cotton of textile mills in and around Tamil Nadu is 0.8 million bales per annum. The balance is met through imports. Attempts have been made to identify high yielding extra long staple *G. barbadense* genotypes with desirable fibre property. In the process of identification of genotypes, seed cotton yield coupled with superior fibre quality properties are considered as the prime factors.

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Seed cotton yield is a complex trait governed by several yield contributing characters such as plant height, number of monopodia, number of sympodia, number of bolls, number of fruiting points per plant. In cotton, genotypic and phenotypic variation for different agronomic and fibre quality characters such as plant height, number of monopodia, number of sympodia, number of bolls, number of fruiting points per plant, seed index, lint index, micronaire value and seed cotton yield has been extensively studied by several workers (Krishna Rao and Marry 1990, Rajarathinam and Nadarajan 1993, Sumathi and Nadarajan 1996, Sambamurthy *et al.* 1998, Ahuja and Tuteja 2000, Neelam and Potdukhe, 2002, Sakthi *et al* 2007). Since 1970, several extra long staple (*Gossypium hirsutum* x *Gossypium barbadense*) hybrids such as Varalaxmi, DCH-32, NHB-12, HB-224 and TCHB-213 developed at various Institutes were widely cultivated all over the country. However, due to the genetic deterioration of promising released varieties/hybrids, new genotypes with improved fibre properties are desirable to meet the demand in Indian textile industry. The genetic improvement of cotton crop is dependent upon the existence of initial genetic variability among the populations. Therefore the initial variability and the degree and directions of correlations amongst yield attributes are the prerequisite, while aiming at a rational genetic improvement in economic yield through selection approaches in diversified populations. The information on variability and heritability of characters is essential for identifying characters amenable to genetic improvement through selection. Hence, a study was conducted with the broad objective of evaluating the variability in *G. barbadense* genotypes and correlations for yield and yield contributing characters, to ascertain its heritable components of the actual variability for making selection over them.

Material and methods

The field experiment was conducted with the twenty five *G. barbadense* genotypes along with a check Suvin during kharif 2006-2007 at Central Institute for Cotton Research, Regional Station, Coimbatore in a randomized block design with three replications. The name of the accession and their distinct characters are given in Table-1. Each genotype was sown in three rows of 6 m length with spacing of 90 x 60 cm. Recommended package of practices and plant protection measures were adapted to raise a good crop. Observations were recorded on five randomly selected plants in each plot of every replication for seed cotton yield (g/plant) and other agronomic viz., plant height (cm), number of nodes per plant, days to 50% flowering, monopodia per plant, sympodia per plant, bolls per plant, fruiting points per plant, seed index (g), lint index (g), and fibre quality characters such as ginning out turn (%), 2.5% span length (mm), bundle strength (g/tex), micronaire value(µ/inch) and maturity ratio as per the standard procedure. From the mean values of each character, variability, heritability and correlations were estimated as per the procedure outlined by Singh and Chaudhary (1977).

Results and Discussion

There was considerable level of genetic variability among the genotypes observed for the characters under study. Analysis of variance revealed high genotypic and phenotypic coefficients of variation for fruiting points/plant (119.3 & 67.96), days to 50% flowering (70.1 & 54.8), ginning outturn (53.5 & 29.54), 2.5 % span length (43.2 & 31.8), bundle strength (36.0 & 27.8) and number of bolls/plant (17.0 & 12.9) and seed cotton yield (38.7& 18.4) indicating ample scope for genetic improvement of these traits through selection. The observed variability (phenotypic variance) was partitioned in to heritable (genotypic variance) and non heritable (environmental variance) components (Table-2). This variation among the population reflects the diverse origin and distribution of the genotypes. Similar results were reported by Krishna Rao and Mary (1990) and Rajarathinam *et al.* (1993) for number of bolls per plant; Rajarathinam *et al.* (1993), Rao and Reddy (2001) and Neelam and Potdukhe (2002) for 50% flowering and seed cotton yield and Nadarajan and Sreerangasamy (1990) and Rao and Reddy (2001) for ginning percentage and 2.5% span length. The genotypic, phenotypic and environmental coefficients of correlation showed that the genotypic correlations were higher than the phenotypic and environmental ones for most of the characters exhibiting high degrees of genetic association among traits under consideration. The environmental correlation coefficients were not significant in most of the cases, indicating low environmental influence in the experiment. Similar findings were reported by Neelam and Potdukhe (2002). Their study on different genotypes of upland cotton revealed that the genotypic correlation coefficients for all the characters studied were higher than the phenotypic and environmental correlation coefficients.

Heritability and Genetic advance

Genotypic coefficient of variation does not give the idea of total variation that is heritable. The relative amount of heritable portion of variation can be assessed through heritability estimates. Heritability estimates give an idea about the effectiveness with which selection can be practiced for genetic improvement of a particular character based on phenotypic performance. High heritability coupled with high genetic advance was observed for seed cotton yield (89.53 &46.34), days to flowering (82.24 & 54.05), number of bolls/plant (83.41 & 26.19), number of fruiting points/plant (72.65 & 16.22), indicating the possibility of improvement of these traits through selection. These results are in conformity with those of Rajarathinam *et al.* (1993), Sambamurthy and Rao (1998), and Rao and Reddy (2001) for number of sympodia and bolls per plant, Sambamurthy and Rao (1998) and Ahuja and Tuteja (2000) and Sakthi *et al.* (2007) for seed cotton yield. High heritability accompanied with high genetic gain indicate that these traits are under the control of additive gene action and directional selection for these traits in the genetically diverse material could be effective for desired genetic improvement.

Correlation between yield and yield components of hybrids

Genotypic correlation

Seed cotton yield was positively correlated with number of bolls per plant (0.6516) and number of fruiting points per plant (0.8827) which indicated that higher mean values for these traits can increase the seed cotton yield. Positive correlation of seed cotton yield with number of sympodia (0.5631) and number of bolls per plant (0.6516) showed that these characters would increase indirectly associated with yield, whereas number of monopodia (-0.3324) and number of nodes per plant (-0.5182) may lead to have low yield. The magnitude of genotype correlation coefficients for most of the characters was higher than the corresponding phenotypic ones. It was observed that number of bolls per plant, seed index and lint index were positively correlated with seed cotton yield per plant and they are intercorrelated with each other. Hence, breeder should concentrate on the above parameters for improving seed cotton yield in cotton. Sumathi and Nadarajan (1996) and Rao and Reddy (2001) reported similar findings for number of bolls per plant.

Positive and consistent correlation of sympodial branches with boll number (0.7401), seed index (0.8921) and lint index (0.8861) was observed. Plant height had negative correlation with number of monopodia (-0.2913) fruiting points per plant (-0.5082) and number of node/plant (-0.3635). The ginning percentage exhibited negative correlation with fibre bundle strength (-0.9422). However, fibre length showed positive and significant correlation with fibre bundle strength (0.7691). Rajarathinam *et al.* (1993) and Rao and Reddy (2001) also reported similar findings.

Phenotypic correlation

Positive and consistent phenotypic correlation of sympodial branches with boll number (0.7401, seed index (0.8921) and lint index (0.8861) was observed. Plant height had negative correlation with number of monopodia (-0.2913) fruiting points per plant (-0.5082) and number of nodes/plant (-0.3635). The ginning percentage exhibited negative correlation with fibre bundle strength (-0.9422). However, fibre length showed positive and significant correlation with fibre bundle strength (0.7691). Tomar *et al.* (1992) also reported similar findings in upland cotton (*G. arboreum*). The magnitude of genotypic correlation coefficients for most of the character was higher than the corresponding phenotypic ones.

The genetic improvement in cotton is possible through selection exercised for those characters which showed high values of GCV, PCV, heritability and genetic advance. The characters such as lint index, number of monopodia/plant, number of fruiting points/plant and bundle strength indicated high heritability and low genetic advance shows that improvement is possible through heterosis breeding. As the seed cotton yield showed positive correlation with several yield contributing characters such as number of fruiting points per plant and boll number per plant etc; there is an ample scope for the genetic improvement of *G. barbadense* genotypes.

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Table-1. Name and distinct characters of the *G. barbadense* L genotypes

S .No	Name	Distinctive features
1	Tenwish	High strength, length genotype with moderate fibre fineness
2	USSR Mix-76	High strength, length genotype with high ginning percentage
3	Sea Island-3	High strength and length genotype with moderate yield
4	Pima-2	High strength, length genotype with moderate fibre fineness
5	Pima-3	High strength, length genotype with high ginning percentage
6	PimaS-2	High length genotype with good fineness
7	Pima-S-2 (SB)	High strength, genotype with high ginning percentage
8	Barbados	High length genotype with fibre fineness
9	Giza-45	High strength and length genotype
10	Giza-7	High strength, genotype with good fibre fineness
11	Giza-7-1461	High length genotype with moderate yield
12	Giza-1461	High strength, length genotype
13	Menofi	High, strength genotype with high ginning percentage
14	SIA-4	High length genotype with high ginning percentage
15	Sea Island -339	High length genotype with good fibre fineness
16	Sujata	High strength, with good fibre fineness
17	Suvin	High strength, length genotype with moderate yield
18	Tadla	High strength, high length genotype with ginning percentage
19	EC-97633	High strength, genotype with good fibre fineness
20	EC-97635	High high strength and length genotype
21	EC-101784	High strength, genotype with fibre fineness
22	Giza-70	High strength, high length genotype with moderate ginning percentage
23	Giza-129	High strength and high length genotype
24	Giza-181-961	High strength, high length genotype with fibre fineness
25	Karnak	High strength, high length genotype with fibre fineness

Table -2. Mean, range and genotypic, phenotypic and environmental variances for various characters *in G .barbadense* L genotypes

Characters	Mean	Range	Variances		
			Genotypic ($\sigma^2{}_g$)	Phenotypic ($\sigma^2{}_p$)	Environmental ($\sigma^2{}_e$)
Plant height (cm)	72.6	58.0-89.3	0.03	0.02	0.01
Days to 50% flowering	65.3	54.2-73.0	70.12**	54.80 **	3.16
Nodes/plant	6.71	4.5-71.2	30.93*	4.97	23.14
Monopodia/plant	1.2	0.6-1.8	0.16	0.23	8.92
Sympodia/plant	13.4	10.3-15.5	4.05	9.13	20.69
No. of bolls/plant	52.0	39.5- 73.7	17.06*	12.97*	22.70
Fruiting point/plant	54.1	46.2-69.4	119.30 **	67.96**	17.36
Seed index	5.7	3.3-7.5	0.94	1.05	8.95
Lint index	3.6	2.9-4.4	9.13	5.19	11.06
GOT (%)	30.2	28.4-33.3	53.58**	29.54	3.33
2.5% Span length (mm)	34.0	30.0-37.1	43.20**	31.85 *	7.81
Micronaire value (mm)	3.3	3.0-4.2	0.19	0.22	13.86
Maturity coefficient	0.6	0.2-0.8	10.02*	7.01	9.08
Bundle strength	26.3	21.0-29.0	36.04**	27.85*	10.01
Seed cotton yield (g)	33.6	29.0-37.5	38.77**	18.42*	14.52

* Significant at 0.5 % ** Significant at 1 %